Operating Experience Weekly Summary 97-41

October 3 through October 9, 1997

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EVENTS

1. VACUUM CLEANER FIRE AT OAK RIDGE

On September 30, 1997, at the Oak Ridge Y-12 Site, a vacuum cleaner being used to vacuum depleted uranium chips from a boring machine caught on fire. A machine shop supervisor noticed smoke coming from the vacuum cleaner, unplugged it, and pushed it outside to a loading dock, where it began to flame. The supervisor extinguished the fire with a nearby fire extinguisher, but smoke was still coming from the vacuum motor. He directed all personnel to evacuate the area and notified the operations manager who, in turn, notified the fire department. Fire department personnel responded to the scene and extinguished the fire. The fire did not result in any personnel injuries, release of radioactive materials, or facility damage. (ORPS Report ORO--LMES-Y12NUCLEAR-1997-0042)

Investigators reported that radiological control personnel requested whole body counts and bioassay samples from all personnel who were near the vacuum cleaner or responded to the fire. They also took air samples, performed surveys, and determined that no contamination was released as a result of the fire.

The facility operations manager held a critique and initiated an investigation to determine the cause of the fire. Investigators have not determined if the depleted uranium chips ignited or if the fire was caused by an electrical or mechanical failure of the vacuum cleaner motor. Facility personnel are continuing an investigation to determine the cause and establish corrective actions.

NFS reported similar events in Weekly Summaries 97-07, 96-33, and 96-30.

- Weekly Summary 97-07 reported that a machine shop operator at Lawrence Livermore National Laboratory ignited a pile of depleted uranium chips when he created a spark with a hand file while removing a burr on a depleted uranium part. The fire was contained within a bandsaw enclosure. When they saw the fire, other personnel in the area evacuated and notified the fire department. (ORPS Report SAN--LLNL-LLNL-1997-0010)

- Weekly Summary 96-33 reported that air pre-filters at Sandia National Laboratory caught fire inside a glovebox while a laboratory technician was vacuuming fine stainless steel powder. Investigators determined that a static discharge occurred when the nozzle of the vacuum contacted the foam material of a pre-filter, causing a pyrophoric reaction of the stainless steel powder embedded in the foam. (ORPS Report ALD-KO-SNL-1000-1996-0006)

- Weekly Summary 96-30 reported that a laboratory technician at Sandia National Laboratory was vacuuming titanium powder in a glovebox when the vacuum cleaner he was using caught fire. Investigators believe that static produced during vacuuming may have ignited the titanium powders in the vacuum cleaner bag. The vacuum cleaner was neither grounded nor explosive-resistant. The technician carried the vacuum cleaner outside the building and extinguished the fire with a fire extinguisher. (ORPS Report ALO-KO-SNL-1000-1996-0005)

These events illustrate the importance of using caution when working with processes involving combustible or potentially pyrophoric metals. Personnel involved with such activities should fully

understand the potential reactions and consequences of the materials used in the process. Hazards that could cause or contribute to the severity of a combustible metal fire should be identified by a hazard analysis, and measures to minimize the hazards should be implemented.

DOE-HDBK-1081-94, *Primer on Spontaneous Heating and Pyrophoricity*, provides information for the identification and prevention of potential spontaneous combustion hazards. The handbook contains information on the effects that atmospheric oxygen, moisture, heat transfer, and specific areas have on spontaneous heating and ignition. It also identifies metals and gases known to be pyrophoric, acceptable methods for long-term storage, proper extinguishing agents, and additional sources of reference materials available on these subjects. A copy of the handbook is available on the Internet at URL http://www.doe.gov/html/techstds/standard/standard.html.

The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as fires. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in parallel to provide defense-in-depth and to increase the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

A copy of *The Hazard and Barrier Analysis Guide* is available from Jim Snell, (301) 903-4094, and may also be obtained by contacting the ES&H Information Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-72/Suite 100, CXXI/3, Germantown, MD 20874.

KEYWORDS: pyrophoric, fire, uranium, vacuum cleaner

FUNCTIONAL AREAS: Hazards Analysis, Materials Handling/Storage

2. WORKER CONTAMINATED BECAUSE OF TEAR IN GLOVE

On September 30, 1997, at the Los Alamos National Laboratory, an actinide process chemistry worker was contaminated because of a tear in a glovebox glove. Radiological control technicians detected low-level alpha contamination on his chest and on his protective clothing. The technicians detected the contamination when they responded to a continuous area monitor alarm. Two other workers were also in the room when a continuous air monitor alarmed. All three workers exited the area following the alarm. The radiological control technicians took nasal smears from all three workers. The nasal smears indicated that the contaminated worker also received a potential low-level plutonium intake. The other two workers had less than minimum detectable levels. Post-alarm surveys and inspections indicated that the glovebox glove was torn. Failure of a glovebox glove resulted in the spread of contamination and a radiological uptake. (ORPS Report ALO-LA-LANL-TA55-1997-0036)

Investigators determined that the radiological control technicians had satisfactorily performed a monthly glovebox integrity check on September 25, 1997. They also determined that the contaminated worker had not inspected the glove before beginning work. Investigators located a tear on the underside of the glove, above the elbow. They believe that, because of the location of the tear, the worker may not have seen it, even if he had inspected the glove. Radiological control technicians surveyed areas adjacent to the glovebox and found 400 to 800 dpm/100 cm^2 on the floor. They also measured the fixed-head air sample filters and found 400 to 2,000 dpm. They sent the filters to the health physics analysis laboratory for further analysis.

The facility manager held a critique and learned that the radiological control technicians did not ask two of the workers to submit bioassay samples. Dose assessment personnel have since required these two workers to submit samples. The facility manager restricted all three employees from working in the facility until final dose assessment analysis results are completed. He also initiated an investigation of the event to determine the cause and corrective actions.

NFS reported similar events in Weekly Summaries 96-26, 95-45, and 95-32.

- Weekly Summary 96-26 reported that a laboratory technician at Savannah River HB-Line detected contamination on the outside of her protective clothing after handling samples in a glovebox. She notified a radiological control inspector who surveyed her arm and confirmed the presence of more than 1 million dpm alpha contamination on her right inner forearm and contamination on both the inner and outer layers of her protective clothing. Investigators believe the technician was contaminated when she stretched the glove to reach an object in the back of the glovebox. (ORPS Report SR--WSRC-HBLINE-1996-0011)

- Weekly Summary 95-45 reported that a radiological specialist at Los Alamos found contamination on the palm of her right glove after working in two different gloveboxes. Radiological control technicians performed surveys and found contamination inside the right glove in both gloveboxes and a 1-inch tear in the forearm area of the second set of gloves used by the specialist. Investigators determined that the damaged glove was folded, then stored for at least 2 years, resulting in a crease in the forearm area. They believe that the glove tore at the crease, and contamination migrated through the tear. (ORPS Report ALO-LA-LANL-CMR-1995-0019)

- Weekly Summary 95-32 reported that the DOE Albuquerque Operations Office issued a lessons-learned memorandum to the Albuquerque and Kirtland Area Managers concerning a series of glovebox failures at the Los Alamos National Laboratory Plutonium Processing Facility. Pinhole leaks in recently installed gloves led to five instances of alpha contamination, ranging from 1,000 to 100,000 dpm, on personnel protective clothing. Los Alamos engineers traced the cause of the failures to inadequately finished expander rings used to install new gloves. (ORPS Report ALO-LA-LANL-TA55-1995-0030)

OEAF engineers reviewed the ORPS database and found 331 torn glovebox glove events. Figure 2-1 shows the distribution of direct causes for these events. Equipment/material problems represented 45 percent of the direct causes; management problems accounted for 22 percent; and personnel error accounted for 21 percent. Defective or failed material accounted for 80 percent of the equipment/material problems; inadequate administrative control accounted for 68 percent of the management problems; and other human error accounted for 68 percent of the personnel errors.

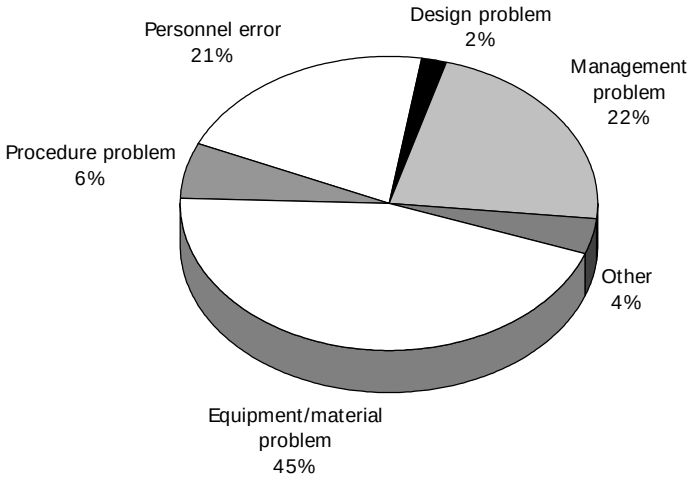

Figure 2-1. Distribution of Direct Causes for Torn Glovebox Gloves[1]

These events illustrate the importance of performing thorough inspections of glovebox gloves before using them. OEAF engineers contacted two glovebox glove manufacturers. According to the manufacturers, the service life of gloves typically used for radiological protection in glovebox applications is dependent upon several factors. These factors include glovebox environment, types and physical characteristics of the materials being handled, exposure to chemicals or cleaning agents, and the physical degree of the work being performed. Facility managers should ensure that their procedures require a thorough inspection of gloves before each use, and they should emphasize to the workers the importance of performing these inspections.

DOE/EH-0256T, *Radiological Control Manual*, section 347, describes controls required for glovebox operations, including requirements that gloveboxes be inspected for integrity before use and that glovebox users monitor their hands periodically during work. Information is also available for glovebox users from the American Glovebox Society. The Society can be contacted at 1-800-530-1022 or by writing to P.O. Box 9099, Santa Rosa, CA 95405-1099. Information is also available on the Society's Home Page at URL http://www.esper.com/ags.

KEYWORDS: glove, continuous air monitor, glovebox

FUNCTIONAL AREAS: Radiation Protection, Surveillance

3. BACKHOE PULLS DE-ENERGIZED CABLE ACROSS ENERGIZED BUS BAR

[1] OEAF engineers searched the ORPS database using the graphical users interface for reports with all narrative “glove AND (torn OR tear OR rip@)” and found 146 reports describing 331 events. Based on a random sampling of 20 events, OEAF engineers determined that each slice is accurate within ± 2 percent.

On September 30, 1997, at a Los Alamos National Laboratory construction site, a subcontract backhoe operator pulled two de-energized 480-volt cables through a conduit with the teeth of the backhoe bucket and across an energized bus bar. The two cables pulled loose from their breaker connections inside a 480-volt switchgear and re-energized when the exposed copper cable ends contacted the incoming side of the energized bus bar. When the backhoe operator saw sparks, he immediately raised the bucket and moved the backhoe out of the area. Investigators determined that a communication error between the backhoe operator and a crew of electricians resulted in the incident. The backhoe operator incorrectly believed the electricians had already cut the cable to allow its removal. Although there was no impact on the health and safety of personnel or the environment, a communication breakdown resulted in the excavation of an energized cable and the potential for electrical shock. (ORPS Report ALO-LA-LANL-LANL-1997-0001)

A subcontractor was excavating for the construction of a change room. The subcontractor referenced as-built drawings and used utility locators to find buried utilities in the construction area. The only utilities in the area were an abandoned telephone line, a storm drain (which was removed), and a 480-volt line contained in an underground 4-inch steel conduit. Electricians had de-energized the line by opening and locking its circuit breaker. The excavation plan included removing the de-energized and locked-out power cables from the conduit, then removing the conduit with the backhoe.

The backhoe operator stopped his excavation when he initially located the conduit and asked an electrical crew what should be done. The electrical crew checked with their foreman. He explained that the electrical cables and conduit would be cut with a bandsaw so the backhoe could remove them. The electrical crew then explained to the backhoe operator that the plan was to cut the cables. The backhoe operator incorrectly understood that the cables were cut and ready for removal. The re-energized cables caused a single-phase condition across the primary bus bar, raising the current on the remaining two phases and tripping a feeder breaker.

NFS has reported severed cables and excavation events in numerous Weekly Summaries. The following are recent examples.

- Weekly Summary 97-36 reported that a subcontractor at the Idaho National Engineering Environmental Laboratory cut an energized 208-volt line while core-drilling a cinder block wall to enlarge existing wall penetrations. A breakdown in communication between the construction manager for the primary contractor and the subcontractor resulted in drilling into a location where an energized line was known to exist on the opposite side of a wall. (ORPS Report ID--LITC-WASTEMNGT-1997-0021)

- Weekly Summary 97-33 reported four events where workers severed underground electrical and telephone lines. At Hanford, a subcontractor performing renovation activities in a building basement cut a conduit containing an energized 110-volt line. At Lawrence Livermore National Laboratory, a contractor cut an underground energized 480-volt line while using construction equipment to loosen the soil surface. At the Hanford Waste Encapsulation and Storage Facility, a backhoe operator performing excavation severed an abandoned underground telephone line. When work resumed on the next day, the backhoe operator severed an abandoned, de-energized electrical cable. (ORPS Reports RL--PHMC-WESF-1997-0007, RL--PNNL-PNNLBOPER-1997-0023, and SAN--LLNL-LLNL-1997-0051)

This event is significant because the subcontractor successfully performed all excavation perquisites for identifying buried hazards by (1) using an excavation permit, (2) using locating devices for utilities, (3) reviewing as-built drawings, and (4) electrically isolating the cable with a

lockout. However, even with physical, procedural, and administrative barriers in place, a failure in the final barrier, "human action," negated the other barriers. Human action can be considered a barrier to provide controls over hazards associated with a job. The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that control job-associated hazards, such as physical barriers, procedural or administrative barriers, or human action. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in series to provide defense-in-depth and to increase the margin of safety. The guide provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards. A copy of the guide is available from Jim Snell, (301) 903-4094, or by contacting the ES&H Information Center, (301) 903-0449, or by writing to ES&H Information Center, U.S. Department of Energy, EH-74, Suite 100, CXXI/3, Germantown, MD 20874.

Managers and supervisors should review DOE-STD-1031-92, *Guide to Good Practices for Communications,* which provides guidance to improve communications effectiveness. They also should review DOE/EH-0541, Safety Notice 96-06, "Underground Utilities Detection and Excavation." The notice provides descriptions of recent events, an overview of current technology for detection of underground utilities, and specific recommendations for improving excavation programs and detecting site utilities. The notice includes innovative practices used at DOE facilities. Safety Notice 96-06 also can be obtained by contacting the ES&H Information Center. Safety Notices are also available on the Operating Experience Analysis and Feedback Home Page at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html.

KEYWORDS: communications, barrier, excavation, cable, electrical shock

FUNCTIONAL AREAS: Industrial Safety, Hazards and Barrier Analysis

PRICE ANDERSON AMENDMENTS ACT (PAAA) INFORMATION

1. PRELIMINARY NOTICE OF VIOLATION FOR WORK PROCESS DEFICIENCIES

On September 19, 1997, the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation under the Price-Anderson Amendments Act to Lockheed Martin Idaho Technologies Company (LMITCO) at the Idaho National Engineering and Environmental Laboratory. Investigators were concerned about these violations because they were not isolated incidents, but occurred at five nuclear facilities between February 24, 1997, and April 8, 1997, and resulted in six different occasions when the operational safety requirements and technical specification requirements were not met. Operating nuclear facilities outside the parameters of their safety authorization basis can result in conditions that could compromise worker and public safety. [NTS Reports NTS-ID-LITC-ATR-1997-0001 and NTS-ID-LITC-PBF-1997-0001; Letter, DOE (P. Brush) to Lockheed Martin Idaho Technologies Company (W. Denson), 09/19/97]

The Office of Enforcement and Investigation staff conducted an investigation of the following events and identified them as Severity Level III violations. A Severity Level III violation is characterized as a less than serious violation. If left uncorrected the violation could lead to more serious safety concerns. Each of these events is a violation of the provisions in 10 CFR

830.120(c)(2)(i), "Work Processes." This rule requires that work shall be performed to established technical standards and administrative controls using approved instructions, procedures, or other appropriate means.

- Operators at the Advanced Test Reactor moved an experiment cask over the fueled reactor vessel without having first met the requirement of establishing reactor building confinement. Had the cask dropped and compromised fuel integrity, a release of radioactivity to the environment could have resulted.

- Operators at the Idaho Chemical Processing Plant fuel storage basin removed a fuel handling unit from a fuel shipping cask and failed to ensure the other fuel handling units in the cask remained in the approved storage condition as required. (ORPS Report ID--LITC-FUELRCSTR-1997-0002)

- Personnel at the Test Reactor Area did not perform a physical inspection or prove compliance with approved procedures during an annual criticality audit of a nuclear materials inspection and storage facility, as required. The facility was in violation of procedures for the storage of eight unauthorized fuel rods. (ORPS Report ID--LITC-TRA-1997-0007)

- Personnel placed a shipment of new Advanced Test Reactor fuel containing 47.3 kg U-235 in an out-of-vault storage without protective measures. Specifications require that no more than 19.999 kg of fissile material can be out of a special nuclear material storage vault unless protective measures are in place.

- Inspectors at the Power Burst Facility did not conduct a surveillance to verify structural integrity and minimum neutron absorber thickness of fuel storage racks within the time period specified. They performed the surveillance almost 2 months after a 6-month grace period ended. (ORPS Report ID--LITC-PBF-1997-0004)

- Workers at the Material Test Reactor canal performed maintenance on a canal level instrument and failed to ensure that the system was operable or to implement visual observation and level recording as required.

Investigators also identified a violation of the provisions in 10 CFR 830.120(c)(1)(iii), "Quality Improvement." Between March 1996 and April 1997, LMITCO management failed to correct the use of an inappropriately developed maintenance work order for calibrating components in a safety-related system, even though workers reported problems in performing the calibrations in March 1996. The work order contained inadequate instructions for performing the work and had an inappropriate quality level assigned for maintenance on a safety-related system. Workers used the work order on April 8, 1997, to perform a calibration that resulted in the system being left in an inoperable condition for more than 2 hours. 10 CFR 830.120(c)(1)(iii) requires establishment and implementation of processes to detect and prevent quality problems.

LMITCO management has 30 days to reply to the Preliminary Notice of Violation and admit or deny the alleged violations. The Preliminary Notice of Violation will become final if they admit the allegations and provide sufficient corrective actions within the 30-day period.

The Price-Anderson Amendments Act subjects DOE contractors to penalties for violations of DOE rules, regulations, and compliance orders relating to nuclear safety requirements. The Office of Enforcement and Investigation may reduce penalties when a DOE contractor promptly identifies a violation, reports it to DOE, and undertakes timely corrective action. DOE has discretion to not

issue a notice of violation in certain cases. The Noncompliance Tracking System (Weekly Summaries 95-17, 95-20) provides a means for contractors to promptly report potential noncompliances and take advantage of provisions in the enforcement policy.

KEYWORDS: work control, technical safety requirement, operational safety requirement, surveillance, enforcement, Price-Anderson Act

FUNCTIONAL AREAS: Licensing/Compliance, Work Planning

2. PRELIMINARY NOTICE OF VIOLATION FOR PLUTONIUM UPTAKES

On September 19, 1997, the DOE Office of Enforcement and Investigation issued a Preliminary Notice of Violation under the Price-Anderson Amendments Act to Bechtel Hanford, Inc. (BHI). The notice involved two incidents that resulted in small, but unplanned, uptakes of plutonium by five Hanford workers as a result of inadequate radiological work controls. On January 29, 1997, a decontamination and decommissioning worker received an uptake of Pu-239 and Cs-137 while removing a plywood cover to probe the sediment in a fuel transfer pit in the 105-C reactor building. On September 4, 1996, four workers received uptakes while performing periodic inspection and surveillance of 224-B Facility canyon cells. Both events resulted from apparent noncompliances with the provisions of the Occupational Radiation Protection Rule, 10 CFR 835. The maximum internal exposure from these incidents was 120 mrem; however, the exposures were unplanned and preventable. [NTS Report NTS-RL--BHI-DND-1997-0002; Letter, DOE (P. Brush) to Bechtel Hanford, Inc. (S. Liedle), 09/19/97]

In the first incident, radiological control supervisors did not require pre-job surveys and relied on results from a routine survey program. However, previous surveys never documented alpha contamination in the fuel transfer pit area, even though 20 percent of the sediment contamination was comprised of Pu-238, Pu-239, Pu-241, and Am-241. Radiological control technicians surveyed the workers upon exit for beta/gamma contamination, but did not survey for alpha contamination or take nasal smears. The contaminated worker's committed effective dose equivalent was 120 mrem. (ORPS Report RL--BHI-DND-1997-0009) In the second incident, radiological control personnel used a radiation work permit for entry into the cells that was based on a 6-month-old survey. Samples in the cell area identified alpha contamination above the "stop work" hold point in the radiological work permit, but the samples were not analyzed until after the surveillance was finished. Two workers received an internal exposure of 16.75 mrem committed effective dose equivalent; the other two received 22 mrem. (Weekly Summary 96-40 and ORPS Report RL--BHI-DND-1996-0021)

The Office of Enforcement and Investigation staff conducted an investigation of these events and identified several Severity Level III violations. A Severity Level III violation is one characterized as less than serious. If left uncorrected a Severity Level III violation could lead to more serious safety concerns. The violations included the following.

- Radiological control personnel did not perform actions intended to detect and quantify radiological conditions in the canyon cells or the fuel basin transfer pit. They did not quantify removable contamination and airborne radioactivity levels before personnel entered the cells or before personnel manipulated the plywood cover for the fuel transfer pit.

- Radiological control personnel used instruments sensitive only to beta/gamma radiation to monitor workers at the job-site exit of the fuel basin transfer pit, while the primary exposure hazard to the workers was alpha radiation.

- Radiological control personnel removed signs at the access point to the F and G cells that stated "Caution, Airborne Radioactivity Area" and "Danger, High Contamination Area," before workers entered the cells. Airborne radioactivity was 34.4 times the derived air concentration (DAC) for Pu-239 and 3.9 times the DAC for Am-241. Removable contamination was 12,000 dpm/100 cm^2. The work area access point for the fuel transfer pit was not posted "Caution, Airborne Radioactivity Area." Airborne radioactivity was 0.67 times the DAC for Pu-239 on the basin floor and 48.8 times the DAC at a location 8 feet below the rim of the pit.

- Radiological control personnel did not develop or implement adequate administrative controls or procedural requirements to maintain radiation exposures as low as reasonably achievable in either incident. The procedure for radiological work permits requires radiological surveys before writing the permit if the survey data is older than 3 months. The procedure for planning radiological work requires a pre-job survey and pre-job walk-down before work can be performed. Also, although the procedure for field air sampling states that a portable alpha survey meter will not detect 10 percent of a DAC for Pu-239 and Am-241 in a timely manner, instructions on how to proceed with field air sampling in these situations were not provided.

BHI management undertook further radiological characterization of the canyon cells as a result of the September 4, 1996, worker uptakes. Corrective actions included personnel retraining and procedure upgrading regarding air sampling requirements for job coverage. However, these were not sufficient to prevent a similar occurrence on January 29, 1997. Radiological control personnel did not perform area monitoring before initiating work to adequately delineate radiological conditions under which personnel would conduct work in either of these incidents.

BHI management has 30 days to reply to the Preliminary Notice of Violation and admit or deny the alleged violations. The Preliminary Notice of Violation will become final if they admit the allegations and provide sufficient corrective actions within the 30-day period.

NFS reported issuance of Notices of Violation for radiation protection issues under the Price-Anderson Amendments Act in Weekly Summaries 97-12, 96-30, and 96-43.

KEYWORDS: radiation protection, ALARA, enforcement, Price-Anderson Act

FUNCTIONAL AREAS: Radiation Protection